

CONSTRUCTION STANDARD SPECIFICATION

SECTION 02812

IRRIGATION SYSTEMS

	<u>Page</u>
PART 1 - GENERAL	3
1.1 RELATED DOCUMENTS.....	3
1.2 SUMMARY	3
1.3 RELATED SECTIONS.....	3
1.4 REFERENCES.....	4
1.5 PERFORMANCE REQUIREMENTS.....	5
1.6 SUBMITTALS.....	6
1.7 QUALITY ASSURANCE	6
1.8 DELIVERY, STORAGE, AND HANDLING.....	7
1.9 PROJECT CONDITIONS.....	7
1.10 WARRANTY.....	8
PART 2 - PRODUCTS	8
2.1 PIPES, TUBES, AND FITTINGS.....	8
2.2 PIPING JOINING MATERIALS.....	9
2.3 QUICK COUPLERS	10
2.4 ENCASEMENT FOR PIPING	10
2.5 MANUAL VALVES.....	10
2.6 PRESSURE-REDUCING VALVES.....	11
2.7 AUTOMATIC CONTROL VALVES	12
2.8 BACKFLOW PREVENTION DEVICES.....	12
2.9 MANUAL DRAIN VALVES	13
2.10 PRESSURE REGULATING VALVES – Adjustable.....	13
2.11 MISCELLANEOUS PIPING SPECIALTIES	13
2.12 SPRINKLERS	13
2.13 DRIP IRRIGATION SPECIALTIES	15
2.14 CONTROLLERS	17
2.15 BOXES FOR AUTOMATIC CONTROL VALVES.....	18
PART 3 - EXECUTION.....	18
3.1 EARTHWORK	18
3.2 PREPARATION	19
3.3 PIPING INSTALLATION	21
3.4 JOINT CONSTRUCTION	21
3.5 THRUST BLOCKS (TB).....	22
3.6 VALVE INSTALLATION	22
3.7 SPRINKLER INSTALLATION	23
3.8 DRIP IRRIGATION SPECIALTY INSTALLATION	24
3.9 VALVE BOX INSTALLATION	24

3.10	AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION	24
3.11	FIELD QUALITY CONTROL	25
3.12	BACKFILLING	26
3.13	COMMISSIONING	26
3.14	ADJUSTING	27
3.15	DEMONSTRATION & MAINTENANCE	27
3.16	FINAL INSPECTION AND ACCEPTANCE.	27

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IRRIGATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Piping.
2. Encasement for piping.
3. Manual valves.
4. Pressure-reducing valves.
5. Automatic control valves.
6. Automatic drain valves.
7. Transition fittings.
8. Dielectric fittings.
9. Miscellaneous piping specialties.
10. Sprinklers.
11. Quick couplers.
12. Drip irrigation specialties.
13. Controllers.
14. Boxes for automatic control valves.

1.3 RELATED SECTIONS

- A. Refer to the following sections for related work:

1. Section 01330 – Submittal Procedures. All required submittals shall be per Sandia Construction Standard Specification Section 01330, “Descriptive Submittal Procedures”.
2. Section 02200 – Earthwork. Perform trenching, excavation, boring, backfilling, sleeving, and compacting as required.
3. Section 02510 – Asphalt Concrete, with Standard Detail WU3001 – Utility Crossing at Pavement.
4. Section 02665 – Underground Water Lines for Domestic and Fire Protection Systems.
5. Section 15050 – Basic Mechanical Materials and Methods

6. Section 15310 – Automatic Sprinklers and Water-Based Fire Protection Systems. Refer to this Section for backflow prevention guidelines.
7. Section 16001 – Electrical Work.

1.4 REFERENCES

- A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by basic design only.

1. American Society for Testing and Materials (Latest Edition) – ASTM.
 - A- 674 Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
 - B-32 Standard Specifications for Solder Metal
 - B-88-03 Standard Specifications for Seamless Copper Water Tube
 - B-813-00el Standard Specifications for liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
 - B-828 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 - D-1784 Std. Specification for Plastic Insert Fittings for
 - D-1875 Std. Test Method for Density of Adhesives in Fluid Form
 - D-1785 Std. Specification for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, & 120.
 - D-2241 Std. Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe.
 - D-2464 Std. Specification for Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
 - D-2466 Std. Specification for Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
 - D-2467 Std. Specification for Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
 - D-2564 Std. Specification for Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Piping Systems.
 - D-2609 Std. Practice for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe
 - D-2657 Std. Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
 - D-2683 Std. Specification for Socket Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe.

- D-2774 Std. Practice for Underground Installation of Thermoplastic Pressure Piping.
 - D-2855 Std. Practice for Making Solvent-Cement Joints with Poly Vinyl Chloride (PVC) Pipe & Fittings.
 - D-3139 Specification for joints for Plastic Pressure Pipe using Flexible Elastomeric Seals.
 - D-3261 Std. Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for PE Plastic Pipe and Tubing.
 - F- 402 Std. Practice for Safe handling of Solvent Cements, Primers and Cleaners used for joining Thermoplastic Pipe and Fittings.
 - F-656 Std. Specifications for Primers used in Solvent Cement Joints of Polyvinyl Chloride (PVC) Plastic Pipe and Fittings.
 - F-771 Std. Specification for Polyethylene (PE) Thermoplastic High Pressure Irrigation Pipeline systems.
- 2. American Society of Agricultural Engineers – ASAE.
 - S376.1 Design Installation & Performance of Underground, Thermoplastic Irrigation Pipelines.
 - 3. National Sanitation Foundation - NSF
 - 4. American Water Works Association- AWWA
 - 5. American Society of Mechanical Engineers_ ASME
 - 6. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. -MSS
 - 7. American Society of Safety Engineers - ASSE

1.5 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100% percent irrigation coverage of areas indicated.
- C. Delegated Design (Design/Build type contract): Design 100% percent coverage irrigation system, unless otherwise specified, using performance requirements and design criteria indicated.
- D. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
 - 1. Irrigation Main Piping: 60 psi.
 - 2. Circuit Piping: 60 psi.

1.6 SUBMITTALS

- A. General: Submit the following in accordance with conditions of the contract and Section 01330, Submittal Procedures.
- B. Product Data: All pipe and tubing materials, valves, emitters, bubblers, sprinkler heads, equipment, and accessories shall be submitted for approval. Data shall indicate the maximum allowable operating pressures of each component and any related manufacturing standards and recommendations. Submit manufacturer's literature, technical data, and recommendations for the System as specified.
- C. Shop Drawing: Submit detailed shop drawing showing complete System layout to include irrigation piping and sizes, sprinkler and bubbler heads, emitters, wiring diagram, valves, and controllers (to include mounting detail).
- D. Red-Line Drawings
 - 1. Record drawings noting any variations from the Contract Documents. Submit one copy of record "Red-Line" prints prior to expiration of the required maintenance period.
 - 2. All valves and controllers shall be GPS surveyed. This service can be obtained by paging 505.530.4477.
- E. Controller Chart.
 - 1. Provide a Controller Chart that is 8^{1/2}" x 11" and hermetically sealed. Chart shall be legible [adjust format accordingly] and color-coded for each zone, keying stations of the Controller to valve locations and to irrigation heads served by the station. Place Chart inside door of Controller.
- F. Operation & Maintenance Manual
 - 1. The O&M Manual shall include manufacturer's recommended instructions and maintenance schedule for the complete irrigation system.
 - 2. Provide a copy of the color-coded Controller Chart in the Manual
- G. Spray irrigation system audit test results. Turf areas 10,000 sf and larger shall be audited by an Irrigation Association certified auditor. The following efficiencies shall be minimal: Fixed spray – 60%, rotors – 70%.
- H. Backflow test results.
- I. Pressure test results of system pressure test for 1 hour at 100 psi.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Licensed in landscaping and irrigation systems with not less than five years experience in the type and scale of work required in this Section.
- B. All irrigation work shall be performed by a single firm specializing in this type of work and possessing the State of New Mexico MS06 Irrigation Certification license. Firm shall also provide for at least one on-site employee with a journeyman irrigation license.

- C. Irrigation System: Provide underground irrigation system as a complete unit, including sprinklers, bubblers, drip irrigation heads, controllers, and accessories – produced by acceptable manufacturers as specified herein.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.
- B. Product Handling: Follow manufacturer's published recommendations for handling materials and equipment. PVC pipe shall lay flat during transport and storage.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify SCO no fewer than five days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without SCO written permission.
- B. Existing Conditions:
 - 1. Take precaution to insure that equipment and vehicles do not disturb or damage existing site grading, walks, curbs, pavements, utilities, plants, tree protection zones, and other existing items and elements of the Site. Notify the SCO if rock layer(s) or other unanticipated conditions are encountered underground.
 - 2. Utilities: Verify the locations and sizes of stub-outs for water sources indicated on the Contract Drawings as the source of water supply to the underground irrigation system.
 - 3. Existing Utilities: Prior to excavation, determine the locations of all newly constructed and existing utilities. It is the Contractor's responsibility to obtain all necessary spotting services thru the SCO. Do not damage or disturb underground utilities. If a conflict exists between the location of underground utilities and the proposed work, notify the SCO and arrange for field and design adjustments.
 - 4. Unknown Utilities: In the event that uncharted or incorrectly charted utilities are encountered during excavation that conflicts with this work, all work on that part of the job shall cease until the SCO is contacted and resumption of work is authorized by the SCO.
 - 5. Existing Structures: Use extreme caution when working near existing structures. Do not damage existing features unless specifically indicated on the Contract Drawings. Contractor is responsible for incidental damage caused to existing site features and structures. Repairs shall be made at Contractor's expense.
 - 6. Sequencing/Scheduling: Coordinate irrigation system with related work. Grade site within 1"-inch of finish grade prior to trenching. Install irrigation system prior to plant material installation.

1.10 WARRANTY

- A. General: Warranty underground irrigation system through the specified warranty period [one twelve month calendar period] against operational deficiencies due to inferior material or workmanship. Correct deficiencies immediately as directed by the SCO at no additional cost to SNL, including damage caused by such defects. Repairs shall be completed within ten business days of notification from the SDR.
- B. Settlement: Warranty underground irrigation system through the specified warranty period [one twelve month calendar period] against settlement damage. Adjust, restore, or replace pipes, valves, sprinkler heads, planting, paving, or other improvements or damages caused by settlement at no additional cost to Sandia. These adjustments and restorations include damage caused to adjacent areas that are not part of the project. Damaged areas shall be restored to their original state.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. Ductile-Iron Pipe with Push-on Joint: AWWA C151, with push-on-joint bell and spigot ends.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.
- C. Soft Copper Tube: ASTM B88, Type L (ASTM B88M, Type B), water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- D. Hard Copper Tube: ASTM B88, Type L (ASTM B88M, Type B), and ASTM B88, Type M (ASTM B88M, Type C), water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- E. PE Pipe with Controlled ID: ASTM F771, PE3408 compound; SIDR 11.5 and SIDR 15.
 - 1. Insert Fittings for PE Pipe: ASTM D2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.

- F. PE Pipe with Controlled OD: ASTM F771, PE3408 compound, SDR11.
 - 1. PE Butt, Heat-Fusion Fittings: ASTM D3261.
 - 2. PE Socket-Type Fittings: ASTM D2683.
- G. All valves shall be NSF (National Sanitation Foundation) Certified for potable water.
- H. Pipe and Pipe Fittings
 - 1. Polyvinyl Chloride Pipe (PVC).
 - a. Main and Lateral Lines: All plastic pipe which is 2^{1/2} inches or smaller shall be Schedule 40 PVC and shall conform to ASTM D1785 – continuously and permanently marked with manufacturer's identification, type, class, nominal pipe size, schedule, and pressure rating [in psi] in accordance with the NSF standard.
 - b. Main Lines: All main line pipe which is larger than 2^{1/2} inches in diameter shall be PVC 1120 or 1220 (SDR-PR) pipe, SDR-21 with a 200 psi pressure rating and conforming to ASTM D3139.
 - c. Provide pipes in 20 foot lengths, free of holes, blisters, wrinkles or dents.
Note: Except for drip irrigation systems all systems are designed to 100 psi. Pressure shall be regulated at source connection to operate at manufacturers recommended pressure.
- I. Threaded Nipples: Schedule 80 machined PVC pipe, Type 1, Cell Classification 12454, complying with ASTM D2467.
- J. Line location tape: shall be detectable irrigation line marking tape- Thorbrand or equal. Location tape shall be used on all main and lateral lines.

2.2 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8" inch (3.2 mm) thick unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
- E. Cleaner, Primer and Solvent Cements
 - 1. Cleaner: Uni-Weld 7300 cleaner, ASTM F 656, or approved equal. Cleaner shall be NSF approved.
 - 2. Primer: Uni-Weld 8700, Hi-Etch purple primer, ASTM F656.
 - 3. Cleaner/Primer shall be any color other than clear.
 - 4. Solvent Cements: Uni-Weld 2200 clear, light viscosity type, for lateral lines, Uni-Weld 1700 gray, heavy duty viscosity type, for lateral lines larger than 2^{1/2}" inch diameter, and

Uni-Weld 6700 clear, light viscosity type for Flex/PVC connections – ASTM D 2564.
Solvent shall be NSF approved.

- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
- G. Sealing Tapes and Pastes:
 - 1. Threaded Connections between PVC and Metal Pipe: Rectorseal No. 100 virgin heavy duty sealing paste, Plasto-joint Stick as manufactured by Lake Chemical Company, or Teflon tape.
 - 2. Metal-to-Metal Connection: Rectorseal No.5 slow dry, soft set pipe thread compound.
 - 3. PVC-to-PVC Connections: Teflon tape.
 - 4. Plastic irrigation head or Plastic valve to pipe Connections: Teflon tape. Thread sealing compound shall not be used on thread connections between nipples and plastic valves.

2.3 QUICK COUPLERS

- A. Manufacturers: Subject to compliance with requirements, Provide products by one of the following :
- B. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
 - 1. Hunter Industries Incorporated.
 - 2. Rain Bird Corporation.
 - 3. Weathermatic.
- C. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.

2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105. Class 200 PVC Sleeves, 2x the diameter of the pipe being sleeved.
- B. Form: Tube.
- C. Material: Class 200 PVC
- D. Color: White.

2.5 MANUAL VALVES

- A. Curb Valves: Refer to SNL standard specification 02665
 - 1. Description:

- a. Standard: AWWA C800.
- b. NPS 1 (DN25) and Smaller Pressure Rating: 150 psi (1035 kPa).
- c. NPS 1-1/4 to NPS 2 (DN32 to DN50) Pressure Rating: 150 psi (1035 kPa).
- d. Body Material: Brass or bronze with ball or ground-key plug.
- e. End Connections: Matching piping.
- f. Stem: With wide-tee head.

B. Curb-Valve Casing:

1. Standard: Similar to AWWA M44 for cast-iron valve casings.
2. Top Section: Telescoping, of length required for depth of burial of curb valve.
3. Barrel: Approximately 3" inch (75-mm) diameter.
4. Plug: With lettering "WATER."
5. Bottom Section: With base of size to fit over valve.
6. Base Support: Concrete collar.

C. Shutoff Rods for Curb-Valve Casings: Furnish two steel, tee-handle shutoff rod(s) with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve for Project.

D. Plastic Ball Valves:

1. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating: 150 psi (1035 kPa).
 - c. Body Material: PVC.
 - d. Type: True Union.
 - e. End Connections: Socket or threaded.
 - f. Port: Full.

E. Bronze Gate Valves: Rubber or resilient seated only

1. Description: Manual, bronze, rubber seated

2.6 PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Description:
 - a. Standard: ASSE 1003.
 - b. Body Material: Bronze for NPS 2 (DN50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN65 and DN80).
 - c. Pressure Rating: Initial pressure of 150 psi (1035 kPa).
 - d. End Connections: Threaded for NPS 2 (DN50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN65 and DN80).
2. Capacities and Characteristics:

- a. Size: 1"-3" inch NPS .
- b. Design Flow Rate: 50-150 gpm .
- c. Design Inlet Pressure: 200 psi.
- d. Design Outlet Pressure Setting: 10-75 psi .

B. Flow meter

- 1. Calsense FM flow meter: Additional information can be obtained at <http://www.calsense.com>, or (800) 573.8608.

2.7 AUTOMATIC CONTROL VALVES

A. Brass, Automatic Control Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Rainbird
 - b. Weathermatic
 - c. Hunter Industries
- 2. Description: Red brass body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-VAC solenoid. Valve shall be a reverse flow design.

B. Plastic, Automatic Control Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hunter Industries Incorporated.
 - b. Rain Bird Corporation.
 - c. Weathermatic.
- 2. Description: Molded-glass filled nylon body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-VAC solenoid. With captured plunger and 150 -200 psi rating. Slow closing with fabric reinforced diaphragm.

2.8 BACKFLOW PREVENTION DEVICES

- A. Backflow Prevention Devices shall be installed at the locations indicated and as detailed on the Shop Drawings. The selected device shall be appropriate for the installation and shall comply with COA Cross Connection Control Ordinance. The device shall be a USC approved device.
- B. Pressure Vacuum Breaker shall be installed on all connections without backpressure. (This assembly shall be a minimum of 12" inches higher in elevation than highest point in the piping system and outlet, otherwise the system is considered to be under backpressure). Coordinate installation with the Mechanical Contractor.
- C. Reduced Pressure Assemblies shall be installed on all connections under backpressure.

D. Traditional check valve assemblies are not allowed.

E. Freeze Protection for Backflow Preventors

1. Backflow Preventors shall be protected from freezing temp as required by the COA Cross Connection Control Ordinance as per drawings with either heat tape with built in light indicator or heater.

2.9 MANUAL DRAIN VALVES

A. Description: Brass rubber seated.

2.10 PRESSURE REGULATING VALVES – Adjustable

A. Description: Inlet pressure up to 3000 psi, adjustable outlet pressure from 25-75 psi, seated spring cage, corrosion resistant screws, union inlet construction, stainless steel strainer, bronze body, serviceable in line bypass feature.

2.11 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI WH 201, with bellows or piston-type pressurized cushioning chamber and in sizes complying with PDI WH 201, Sizes A to F.
- B. Pressure Gages: ASME B40.1. Include 4^{1/2}" inch (115mm) diameter dial, dial range of two times system operating pressure, and bottom outlet.

2.12 SPRINKLERS

A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

B. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:

1. Rotary Sprinkler
 - a. Match precipitation rate nozzles
 - b. Low discharge trajectory angle
 - c. Filter Screen
 - d. Use 4" – 6" inch pop-ups in cool season grass areas
 - e. Use 6" – 9" inch pop-ups in native grass seeded area
 - f. MP Rotator or equal

C. Plastic, Pop-up, Impact-Drive Rotary Sprinklers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Rainbird.

- b. Hunter Industries
 - c. Champion Irrigation Products.
 - d. Toro Company (The); Irrigation Division.
 - 2. Description:
 - a. Case: ABS.
 - b. Pop-up Height: Approximately variable 4"- 9" inches.
 - c. Sprinkler Construction: ABS and other corrosion-resistant metals.
 - 3. Capacities and Characteristics:
 - a. Nozzle: As per drawings and Irrigation schedule.
 - b. Flow: As per drawings and Irrigation schedule.
 - c. Arc: As per drawings and Irrigation schedule.
 - d. Radius: As per drawings and Irrigation schedule.
 - e. Inlet: NPS ½" ¾", or 1" depending on brand
- D. Plastic, Pop-up Spray Sprinklers
- 1. Fixed Spray Sprinklers
 - a. Filter screen.
 - b. Use 4" – 6" inch pop-ups in cool season grass areas.
 - c. Matched Precipitation Rates Nozzles
 - d. Adjustable arc nozzles: Use only when odd arcs are required.
 - e. Use 6" – 9" inch pop-ups in native grass seeded areas.
 - f. M P Rotor or equal
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturer:
 - a. Hunter Irrigation.
 - 3. Description:
 - a. Body Material: ABS.
 - b. Nozzle: ABS.
 - c. Retraction Spring: Stainless steel.
 - d. Internal Parts: Corrosion resistant.
 - e. Pattern: Fixed, with flow adjustment.
 - 4. Capacities and Characteristics:
 - a. Nozzle: As per drawings and irrigation specifications
 - b. Flow: As per drawings and irrigation specifications
 - c. Pop-up Height: As per drawings and irrigation specifications
 - d. Arc: As per drawings and irrigation specifications
 - e. Radius: As per drawings and irrigation specifications.
 - f. Inlet: NPS ½" or NPS ¾".

E. Plastic Shrub Sprinklers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hunter Industries Incorporated.
 - b. Rainbird.
 - c. Weathermatic.
2. Description:
 - a. Body Material: ABS or other plastic.
 - b. Pattern: Fixed, with flow adjustment.
3. Capacities and Characteristics:
 - a. Configuration: spaced to achieve matched precipitation .
 - b. Flow: .21 gpm to 5.32 gpm.
 - c. Arc: Full, half, or quarter as needed, and adjustable – Rainbird VAN Series Nozzles circle.
 - d. Radius: 3-18 feet.
 - e. Mounting Height: 6 - 18 inch pop-up installed at grade
 - f. Inlet: ½ inch

F. Plastic Tree Bubblers

1. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturers:
 - a. Rainbird – 1404 series
 - b. Hunter Industries
2. Description:
 - a. Body Material: ABS or other plastic.
 - b. Pattern: Pressure compensating full circle bubbler.
3. Capacities and Characteristics:
 - a. Configuration: two per tree
 - b. Flow: .25 gpm to 2 gpm.
 - c. Arc: Full circle.
 - d. Radius: As per Drawings and irrigation specifications.
 - e. Mounting Height: flush with finish grade on pop-up body.
 - f. Inlet: NPS ½ inch (DN 15)

2.13 DRIP IRRIGATION SPECIALTIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aquarius Brands, Inc.
 2. Olson Irrigation Systems.
 3. Rain Bird Corporation.
- B. Multiple-Outlet Emitter Systems: Emitter with tubing and button-type outlets.
1. Emitter: With multiple outlets to deliver water to remote outlets.
 - a. Body Material: Plastic.
 - b. Outlet Caps: Plastic, for outlets without installed tubing.
 - c. Operation: Automatic pressure compensating.
 - d. Emitters: Devices to deliver water at approximately 15-30 psi.
 - e. Option: Pressure regulating
 2. Tubing: PE or PVC; 1/8" inch (3mm) minimum ID.
 3. Capacities and Characteristics:
 - a. Emitter:
 - 1) Flow: As per drawings and irrigation schedule.
 - 2) Number of Outlets: To be determined by the Architect/Designer.
 - 3) Rainbird XERI –BIRD 8 X BD-80 or XBD- PRO
 - 4) Retain and copy subparagraph below for each emitter.
- C. Drip Tubes with Direct-Attached Emitters:
1. Tubing: Flexible PE or PVC with plugged end.
 2. Emitters: Devices to deliver water at approximately 15-30 psi.
 - a. Body Material: PE or vinyl, with flow control.
 - b. Mounting: Inserted into tubing at set intervals.
 3. Capacities and Characteristics:
 - a. Tubing Size: 1/8 inch.
 - b. Length: Various.
 - c. Emitter Spacing: to be determined.
 - d. Emitter Flow: 1/2 gph - 2 gph .
- D. Off-Ground Supports: Plastic stakes.
- E. Application Pressure Regulators: Brass or plastic housing, NPS 3/4 (DN20), with corrosion-resistant internal parts; capable of controlling outlet pressure to approximately 20 psi . In line pressure regulators for 3/4" inch or 1" inch lines. Inlet pressure from 10-150 psi.
- F. Filter Units: Brass or plastic housing, with corrosion-resistant internal parts; of size and capacity required for devices downstream from unit.
- G. Air Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.

2.14 CONTROLLERS

A. Automatic Controller

1. Calsense Controller ET-2000.
2. Stations: size as indicated on Contract Drawings. Designer shall consider future landscape adjacencies.
3. Controller shall be equipped with a freeze sensor: a single moisture sensor per irrigation zone as indicated on Contract Drawings and grounding rod.
4. Communication Options:
 - a. F
 - b. LR with Sandia Frequency – 422.175 MHz
 - c. RR
5. Controller Enclosure
 - a. Wall Mount: shall be installed in standard two-cabinet application; housing the controller and transient protection board in separate cabinets. Provide stub-out to roof top for antenna.
 - b. Pedestal Mount: use a heavy-duty Stainless Steel enclosure with radio antenna pre-mounted (Model SSE-R).

B. Wiring

1. Provide #14 AWG [min. ga.], type UF, single conductor, solid copper wire, color-coded wiring to electric control valves from automatic controller. Wire shall be UL approved for direct underground burial. Exposed wiring leading to controller shall be in a rigid electrical metallic approved tubing. Multi-strand wire is not acceptable.
2. Provide a single wire to each solenoid from controller and a common neutral wire to all solenoids from controller as power supply.
3. Provide two extra zone wires and one extra common wire to furthest valve location with 36-inch loops in standard size valve box.
4. Indicate wire path and size on Contract Drawings.
5. Refer to the Facilities Design Manual for additional requirements.

C. Dry Splice Connectors

1. Rainbird Snap-Tite wire connectors or Spears DS-400 Dri-Splice connectors or approved equal.

D. Freeze Sensor

1. Calsense compatible

E. Soil Moisture Sensor

1. As manufactured by Calsense.

2.15 BOXES FOR AUTOMATIC CONTROL VALVES

A. Plastic Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Carson/Brooks, Carson Industries LLC.
2. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
 - a. Size: 17"x 30" inch minimum size All valve boxes shall be sized to allow for ease of maintenance access
 - b. Shape: Rectangular.
 - c. Sidewall Material: HDPE.
 - d. Cover Material: HDPE.
 - 1) Lettering: "Irrigation Valve # embossed on the top."

B. Polymer-Concrete Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carson Industries LLC.
2. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
 - a. Size: As required for valves and service.
 - b. Shape: [Round] [Square] [Rectangular].
 - c. Sidewall Material: Polymer concrete with lateral and vertical sidewall design loading of 15,000 lb (6800 kg)] minimum over 10"x 10" inches (254 x 254 mm) square.
 - d. Cover Material: [Polymer concrete] [Reinforced polymer concrete] with cover design loading of 15,000 lb (6800 kg)] minimum over 10" x 10" inches (254 x 254 mm) square.
 - 1) Lettering: "**VALVE BOX - IRRIGATION**"

- C. Drainage Backfill: Cleaned gravel or crushed stone, graded from ¾" inch (19 mm) minimum to 3" inches (75 mm) maximum.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 02200, "Earthwork."

- B. Install warning tape directly above pressure piping, 6" inches (300 mm) below finished grades, except 6" inches (150 mm) below subgrade under pavement and slabs.
- C. Manual Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from ¾" to 1 ½" inches (19 to 75 mm)], to 36" inches (300 mm) below grade. Cover gravel or crushed stone with sheet of weed barrier fabric and backfill remainder with excavated material.
- D. Provide minimum cover over top of underground piping according to the following:
 - 1. Irrigation Main Piping: Minimum depth of 24" inches (900 mm) below finished grade, or not less than 12" inches (450 mm) below average local frost depth, whichever is deeper.
 - 2. Circuit Piping: 18" inches (300 mm).
 - 3. Drain Piping: 18" inches (300 mm).
 - 4. Sleeves: 24" inches (600 mm) for mains, 18" inches for laterals.
- E. Trenching:
 - 1. Stake out all sprinkler head and valve locations prior to trenching for review and approval by the SCO.
 - 2. Excavate trenches straight and true with bottom uniformly sloped to low points. Make excavations of sufficient depth and width to permit proper handling and installation of the pipe and fittings. Accurately trim trenches to provide a uniform bed, free from loose soil, rocks, debris, and other sharp edged objects before installing pipe and fittings. In areas where trees are present, adjust trench location beyond the drip line of the trees.
 - 3. Trench depths in rocky areas shall be 6" inches below required depth to allow for pipe bedding. Pipe installed in rocky soil shall be bedded in 6" inches of sand.
 - 4. Trench widths shall allow a minimum of 4" inches between pipes laid in the same trench.
 - 5. Provide a minimum of 24" inches and a maximum of 26" inches of cover for all constant pressure mainline. Provide a minimum of 18" inches and a maximum of 20" inches of cover for all mainline located downstream of the master valve. Provide a minimum of 18 inches and a maximum of 20" inches of cover for all lateral lines not under constant pressure. Provide a minimum of 6" inches of cover for all ½" inch distribution tubing.
 - 6. Keep bottom of trench or excavation free and clear of water.
 - 7. Where existing pavement must be cut to install landscape irrigation system, saw-cut smoothly to straight lines 6" inches wider than trench. Concrete sidewalks, curb & gutter, shall be removed to the nearest joint or saw-cut as directed by the SCO.
 - a. Repair and replace pavement cuts, sidewalks, curb & gutter with equivalent materials and finishes – match existing. Refer to Section [2] and Standard Detail WU3001 for patching.

3.2 PREPARATION

- A. Installation
 - 1. General

- a. Prior to installing irrigation heads, stake or otherwise locate trees and shrub planting areas. Avoid laying irrigation lines in root ball zone.
- b. Install irrigation material and equipment and provide necessary hardware in accordance with the Contract Drawings.
- c. All connections to the SNL water distribution system must comply with SNL's Standard Specification Section 02665 – Underground Water Lines for Domestic & Fire Protection Systems.

2. PVC Pipe

- a. Main Line: Verify static water pressure at PoC with pressure noted on Contract Drawings. Notify the SCO with any discrepancies prior to proceeding.
- b. Cut pipe square with the axis, using a fine-tooth hand saw, or ratcheting PVC cutter. Blade edge of cutter shall be straight and sharp to assure square burr-free cuts through PVC pipe. Cutter shall have a pipe supporting plate that adjusts to PVC size, and aids in eliminating pipe deformation and cracking. Remove all burrs prior to solvent welding.
- c. Inside of pipes shall be clean and free of dirt, debris, and any foreign matter.
- d. Apply cleaner and solvent in accordance with ASTM D 2855 and manufacturer's recommendations.
- e. All piping in planters is to rest on a gravel filtration layer and is to be placed prior to placement of soil.
- f. Cover and protect open pipe ends, fixtures and equipment from dirt, water, and chemical or mechanical damage during installation.
- g. Do **not** lay pipe in water or in trench when weather conditions are unsuitable for work or when temperature is 32⁰ F or below. Pump out or otherwise remove water encountered or accumulated in excavation to keep the bottom of the trench or excavation free and clear of water during installation.
- h. Compression or flow span couplings are **not** permitted.
- i. Avoid having irrigation pipe crossovers. When pipes cross there shall be a minimum vertical clearance of 4" inches between the pipes and trenching shall be adjusted accordingly to provide required cover.
- j. Vertical stacking of irrigation lines is **not** permitted. Where pipes are laid in the same trench there shall be a minimum horizontal separation of 4" inches between pipes.
- k. There shall be a minimum separation between fittings used on any single piece of pipe of 3" inches between fittings 1 ½" inches or less and 6" inches between fittings 2" inches and larger.
- l. Saddle taps are **not** permitted on lines greater than 2" inches. Refer to the Sandia Specification Section 02665 – Underground Water Lines For Domestic & Fire Protection Systems.
- m. Drain entire system to a manual drain valve(s) placed at the low point(s) in the system. Drain valve shall be installed on lines of nominal pipe size of 1½" inches or less.
- n. Install drain valve in a standard-body plastic valve box with locking cover and sump pit. Drain-gravel backfill shall be 1-cubic foot of cleaned gravel or crushed stone, graded from ¾ inch min. to 1½" inch maximum.
- o. Thoroughly clean fixtures, exposed materials, and equipment.
- p. Install detectable Line Marking Tape meeting the requirements in SNL's Standard Specification 02200 Earthwork on all main lines [lines > ¾" inch]. Place tape 6 "inches above piping.

3.3 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- C. Revise first two paragraphs below to suit Project; delete if not required.
- D. Install (PRV's) water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.
- E. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.
- F. Install piping in sleeves under parking lots, roadways, and sidewalks.
- G. Install sleeves made of Class 200 PVC pipe and socket fittings, and solvent-cemented joints. Two times the size of the pipe sleeved.
- H. Install transition fittings for plastic-to-metal pipe connections according to the following:
 - 1. Underground Piping:
 - a. NPS 1-1/2 (DN40) and Smaller: Plastic-to-metal transition fittings.
 - b. NPS 2 (DN50) and Larger: AWWA transition couplings.
 - 2. Aboveground Piping:
 - a. NPS 2 (DN50) and Smaller: Plastic-to-metal transition [fittings] [unions].
 - b. NPS 2 (DN50) and Larger: Use dielectric flange kits with one plastic flange.
- I. Install dielectric fittings for dissimilar-metal pipe connections according to the following:
 - 1. Underground Piping:
 - a. NPS 2 (DN50) and Smaller: Dielectric coupling or dielectric nipple.
 - b. NPS 2-1/2 (DN65) and Larger: Prohibited except in control-valve box.
 - 2. Piping in Control-Valve Boxes:
 - a. NPS 2 (DN50) and Smaller: Dielectric union.
 - b. NPS 2-1/2 to NPS 4 (DN65 to DN100): Dielectric flange.
 - c. NPS 5 (DN125) and Larger: Dielectric flange kit.

3.4 JOINT CONSTRUCTION

- A. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracks or open welds.
- B. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- C. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.
- D. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
- E. Copper-Tubing Soldered Joints: Apply ASTM B813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20% percent maximum lead content) complying with ASTM B32.
- F. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.
- G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.
1. Plain-End PE Pipe and Fittings: Use butt fusion.
 2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- H. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. PVC Pressure Piping: Join schedule number, ASTM D1785, PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D2855.
 3. PVC Nonpressure Piping: Join according to ASTM D2855.
- 3.5 THRUST BLOCKS (TB)
- A. Install thrust blocks on all lines 2 inches or larger. Size TBs in accordance with ASAE standard S376.1. TBs shall be installed in place against undisturbed earth. Thrust blocks shall be constructed at all direction changes, size changes, valves, and terminations or at any other points of the system that will result in an unbalanced thrust line. Refer to Standard Detail WU5005STD – Water Line Thrust Details/Restraint Details.
- 3.6 VALVE INSTALLATION
- A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
- B. Above ground Valves: Install as components of connected piping system.

- C. Pressure-Reducing Valves: Install in boxes for automatic control valves or aboveground between shutoff valves in Hot box.
- D. Throttling Valves: Install in underground piping in boxes for automatic control valves.
- E. Drain Valves: Install in underground piping in boxes for automatic control valves.
- F. Setting Valves:
 - 1. Do not locate valves beneath paved surfaces.
 - 2. Install valves in a level position.
 - 3. Install all valves, except backflow preventer, with minimum 24" inches cover. Refer to Section 15051, Piping Systems, for backflow preventer installation.
 - 4. Install an isolation valve at the PoC, and at loop or zone isolation points.
 - 5. Install an isolation valve upstream of each electric control valve. Isolation valve may be installed in same valve box with automatic valve.
 - 6. Provide true union ball valves where piping is 2" inches or less.
 - 7. Provide push on ring and gasket type isolation valves where piping is 2½" inches or larger.
 - 8. Install rubber seated valve or true union ball valve as needed. At a minimum, one shall be installed at every hundred feet of mainline in a 12"inch valve box with 3/8" inch gravel.
 - 9. Manual Drain Valves: install at end and low points of the irrigation system. Additional manual drain valves must be installed if there are multiple low points along the system's run of pipe where water collection may occur.
 - 10. Install Reduced Pressure or Pressure Vacuum Breakers in accordance with Section 15051, Piping Systems.

3.7 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 6" inches from walls and other boundaries such as curbs and walks.
- D. Sprinkler Heads,
 - 1. Fully flush entire system prior to the installation of sprinkler and bubbler heads. Cap risers as deemed necessary to achieve adequate flushing.
- E. Bubblers:
 - 1. Bubblers shall be spaced 180° apart and 12" inches from edge of root ball. On sloped surfaces – install bubbler on uphill side of plant material to be irrigated.
- F. Emitters

1. Do not bunch emitters. Space about plant material to provide even irrigation distribution and 6" inches from edge of root ball.

3.8 DRIP IRRIGATION SPECIALTY INSTALLATION

- A. Install multiple-outlet emitter systems with tubing to outlets. Plug unused emitter outlets. Install emitters on multiple-outlet device vs. tubing end outlets on off-ground supports at height indicated.
- B. Install drip tubes with direct-attached emitters on ground.

3.9 VALVE BOX INSTALLATION

- A. Valve boxes shall be installed as shown on the detail drawings and located as shown on the drawings.
- B. Valve boxes shall be installed at and level with finish grade.
- C. Valve boxes shall be engraved or embossed on the top side of the lid with the contents of each valve box. Letters and numbers shall be no smaller than 1 inch and no larger than 1 ½" inches
 1. Control Valves – brand "Zone Valve" and the # of that valve into the lid.
 2. Quick coupling valve – Brand "Q C " into the lid
 3. Wire splices Brand "WS" into the lid.
 4. Isolation valves – "IV"
 5. Drain Valves – "DV".
 6. Air release – "AR"

3.10 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: No interior mounts
- B. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases or wall mounts.
 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Controller Enclosure
 - a. Wall mount shall be installed in standard two-cabinet application; housing the controller and transient protection board in separate cabinets.
 - b. Pedestal Mount: use a heavy-duty Stainless Steel enclosure with radio antenna pre-mounted (Model SSE-R).
- C. Install control cable in same trench as irrigation piping and at least 2" inches (51mm) below [**or beside**] piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

D. Wiring

1. Keep splicing to a minimum. All continual wire shall be of one color. Splicing of different color wires is **not** permitted. Only one splice per any given run is permitted. All splicing, connectors, and splice boxes shall be of a water proof type. All splices shall be placed in a wire-splice-box.
2. Provide 24" inch expansion coils in wiring at each wire connection or change in wire direction and at remote control valves
3. Provide 24" inch expansion loop at remote control valves.
4. Install 24-volt control valve wiring in same trench as main line 2 inches below and to one side of irrigation line. Tape together at 10 foot intervals. Run control wiring through conduit in areas designated on the Contract Drawings. Direct burial is acceptable where approved by the SCO. Run control valve wiring in lateral trench in same manner as in main line trench **only** when it is not possible to use main line trench.
 - a. Do not install run power wiring in the same conduit as control wiring.
 - b. Indicate wire path and size on Contract Drawings.
 - c. Control wires shall be identified with E-Z Coder WDR series tape. Identify wires at all splices, valves, and at controller. Valves shall be numbered according to the Contract Drawings.
 - d. Redundant control wiring shall be color coded as follows: white-common, blue-master valve, red-zone valves, yellow and orange – flow meter.

3.11 FIELD QUALITY CONTROL

A. Inspection – Test & Flushing:

1. Upon completion of the irrigation system, the entire system shall be flushed, tested, and inspected. Notify the SCO in writing 48 hours in advance prior to start of testing.
2. Work done which fails to comply with requirements of this Specification or Contract Drawings will be rejected and shall be immediately removed from the site. Defective work or materials shall be corrected satisfactorily.
3. Flushing: Prior to testing, the entire System shall be partially backfilled, leaving all joints and connections exposed and the entire System shall be flushed clear of all debris, dirt and foreign matter.
4. Testing: A hydrostatic pressure test of main and lateral lines at 100 psi for one hour is required.
 - a. Center – load the mainline piping with a small amount of backfill material, leaving joints and connections exposed. Cap all outlets and hydrostatically test the normally pressurized part (main line) of the system at a pressure of 100 psi. Maintain pressure test for one hour.
 - b. Test laterals in the same manner used for main line. Leave joints exposed for inspection during the pressure test. Do **not** install swing joints prior to pressure test. Maintain pressure tests on plastic pipe for not less than one hour. Do **not** use air pressure test.
 - c. If pressure loss or leaks occurs, affected pipe line or connections shall be repaired and tests shall be repeated until the entire system has been proven tight. Conceal lines passing hydrostatic pressure test the same day if nighttime temperatures are to be 32° Fahrenheit and below. Install pressure gauges on the line being tested.

5. Back Flow Testing:
 - a. Provide test results of RP or PVB testing to SCO.
 6. Irrigation System Audit:
 - a. Provide results of irrigation system audit when required as per submittals section to the SCO.
 7. Following System's testing and adjustments operate the entire installation to demonstrate the complete and successful operation of all equipment. Re-adjust as required, all valves, sprinkler heads, and bubblers for proper operating pressures, uniform coverage and even flow.
- B. Any irrigation product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.12 BACKFILLING

- A. Prior to backfilling trenches, contact the SCO to have valves and other landscape equipment located by Global Positioning System (GPS). This service can be obtained by paging 505.530.4477 to coordinate the GPS Utility Position Survey.
- B. After pipe joints have been visually inspected, flushing and pressure testing performed and accepted, and GPS procedure has been accomplished, and backfilling may begin.
- C. Begin backfilling when the piping is not in an expanded condition due to heat or pressure. Cool piping by operating the system for a short period of time or by backfilling in the cool a.m. hours of the day.
- D. Backfill material shall be free from construction rubbish, rock, large stones, brush, sod, frozen material or other unsuitable substances. When material from excavation or trenching is unsuitable for use as backfill it shall be disposed of, and suitable material which is capable of attaining the required relative density shall be furnished.

3.13 COMMISSIONING

- A. Landscape & Irrigation Commissioning shall be the responsibility of the General Contractor, the Landscape Contractor, the SCO, and the Landscape Architect. At a minimum, the following irrigation equipment and systems shall be commissioned:
 1. 24v Control Wire Installation
 2. Hydrostatic Pressure Test – Main, Laterals, & Electric Control Valves. Master Valve included.
 3. Flow meter
 4. Automatic Irrigation Controller – Installation & Operation.
 5. Local and remote radio operation
 6. Sprinkler, Drip, & Bubbler Heads – Placement, Coverage, & Operating Pressures prior to planting.

7. Backflow Preventer

B. The Contractor shall complete the following documents:

1. Irrigation System Check List
2. Functional Performance Check List

3.14 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than ¼" inch above, finish grade.

3.15 DEMONSTRATION and MAINTENANCE

- A. Train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.
- B. Maintain and adjust the irrigation system in coordination with the plant materials requirements until substantial completion. Irrigation maintenance shall include repair and replacement of parts or workmanship not operating properly and adjustment of timing and coverage of heads.
 1. Provide site consultation with Sandia's G&RS representative.
- C. Record Drawings and Controller Chart:
 1. Maintain a complete set of up-to-date Red-Line drawings and provide a copy to the SCO.
 2. Prepare a controller chart showing:
 - a. Location of all sections, valves, lateral lines, and routes of control wires.
 - b. Identify all valves by size, station, and number.

3.16 FINAL INSPECTION AND ACCEPTANCE.

- A. Upon written request by the Contractor, five days in advance of the end of the maintenance and guarantee period and after substantial completion, an inspection of the irrigation system will be made by the SCO. The Contractor will be notified in writing of the Final Acceptance, or of work required. The Contractor will be responsible for all maintenance until all punch list items are completed and Final Acceptance is granted at which time Sandia will assume responsibility.
- B. Where inspected irrigation work does not comply with the requirements of the Specification and Contract Drawings, replace rejected work and continue specified maintenance until re-inspected by the SDR and the SCO and the work is found to be acceptable. Promptly remove rejected equipment.

- END OF SECTION -